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The present State of the Mining Industries of the United Kingdom.
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(Continued from p. 218.)

The present condition of LEAD MINING will be seen by the following statement of the number of lead mines producing lead ore in each mineral county of the United Kingdom.

The quantities of lead and of silver obtained from the ore for 1854 were as follows: (*the returns for 1855 were not yet completed when this Paper was read.*)

Counties.		Number of Mines.	Lead Ore.	Lead.	Silver.
			Tons.	Tons.	Ozs.
England.	Cornwall	35	7,460	5,005	179,675
	Devonshire	14	4,139	2,612	119,288
	Cumberland	75	9,890	6,662	42,020
	Durham and Nor- thumberland	39	22,329	16,669	78,577
	Westmorland	7	383	289	80
	Derbyshire	not known*	7,554	4,508	....
	Shropshire	10	3,797	2,765	184
	Yorkshire	16	9,244	6,476	....
	Cardiganshire	42	7,034	4,948	33,418
	Caermarthenshire	4	901	666	....
Wales.	Denbighshire	2	1,824	1,363	1,455
	Flintshire	40	7,027	5,408	28,588
	Montgomeryshire	11	1,184	894	3,238
	Merionethshire	3	98	63	....
	Glamorganshire	2	62	45	352
	ISLE OF MAN	2	2,800	2,137	52,262
Ireland.	Clare	3	165	121	6,650
	Down	1	1,379	1,084	....
	Louth	2	54	41	91
	Limerick	3	142	95	3,420
	Wicklow	4	2,228	869	7,935
	Argylshire	1	174	130	536
	Kirkcudbrightshire	4	522	383	570
	Lanarkshire	1	261	170	....
Scotland.	Dumfriesshire	1	795	596	4,320
Total		322	90,553	64,005	562,659

The lead mines of Devonshire, especially those at Coombe-Martin, and Beer-Alston, have been worked from a very early period, and there exist several old charters granting privileges to certain parties upon the payment of fixed royalties to the crown. Sir John Pettus, in his *Fodina Regales*, gives several of these. It is asserted that Edward the Black Prince took 500 miners from Derbyshire into Devonshire, and that the amount of wealth which he obtained in

* The uncertain mode of working in Derbyshire, the constant changes which occur, and the very small quantities of lead ore produced from single workings, render it very difficult to ascertain the number of mines.

that county was sufficient to cover the expenses of his wars in France. It is quite certain that a large quantity of lead ore, especially rich in silver, has, from time to time, been obtained from the Devonshire lead mines.

Lead mining in Cornwall may be said to be of very recent date, since, in the time of Pryce, scarcely any lead was worked. That author informs us that some ancient lead mines exist in Peran-Zabulo, and that, sixty years previously to the time of his writing, at Garres, in St. Allen, lead ore containing 100 ounces of silver to the ton was raised.

The Cardiganshire lead mines were worked by the Romans, and from the time of Henry VII. we have a tolerably complete account of the progress of mining operations in Wales. I have, in "*Notices of the History of the Lead Mines of Cardiganshire*," published in the "Memoirs of the Geological Survey," collected all the information obtainable upon those interesting mineral works. To that paper I must refer all who are interested in the subject.

The lead mines of northern England, especially those of Alston-Moor, appear to have been worked from a very early period. They have exemplified fully many of the uncertainties attending mining operations, fortunes having been lost and won within a very short period by different sets of adventurers.

The most extensive mineral property in England, in the hands of a single individual, is the mines of East and West Allendale and Weardale, the property of Mr. Blackett Beaumont, M.P. for Northumberland. The produce from those mines, in 1854, was 12,220 tons of lead ore, 9,200 tons of lead, and 49,000 ounces of silver. These mines are under the management of Mr. Thomas Sopwith, and they are, in all respects, remarkable examples of systematic order in every department.

The refining of silver from lead is a very ancient process, well described by the poet Job and the prophet Jeremiah. It consisted in oxidizing the lead in a properly constructed furnace, thus converting it into litharge or red-lead, the silver being left on the bed of bone ashes prepared to receive it. While this process was adopted in the north of England, if the lead contained less than 6oz. of silver to the ton, it was not found profitable to separate it; and, in Wales, if it contained less than 12oz., they did not refine the lead. The cost of refining lead, previously to the date of Mr. Pattinson's patent, was from 30s. to 60s. per ton. Mr. Hugh Lee Pattinson discovered a process of desilverization, by which it is now profitable to separate the silver when the ore does not contain more than 3oz. to the ton. Beyond this, more silver is obtained, as Pattinsonized lead never contains more than 7 dwts. of silver to the ton when the process is properly performed, while refined lead seldom contains less than an ounce per ton, and frequently much more.

The quantity of lead now raised is 64,000 tons per annum. Certainly from more than 30,000 tons of this lead the silver is extracted, which, without this process, would have been lost to the arts. This lead will hold from 5oz. to 8oz. of silver per ton, and yield not less than 200,000oz. of silver. On the lead formerly refined there is a saving of the value of at least 3oz. of silver on each ton of lead. The result of this discovery has therefore been the actual recovery of from

60,000*l.* to 70,000*l.* per annum formerly wasted. In the foregoing table, the quantities of silver given are those which have been received in returns obtained from the mines producing argentiferous galena. There are some from which returns have not been obtained, and we may fairly estimate the silver produce from the lead ores of this country as being not less than 790,000 ounces annually.

Of late years a large and steadily increasing trade has sprung up in the argentiferous copper ores and silver ores of South America. It is not possible to obtain any accurate account of the whole of this silver at present.

All copper ores, since 1853, have been imported free of duty; and these argentiferous ores pass into the hands of but two or three smelters without special notice. Some of the copper ores of this country contain silver, and the ores of a few of the Cornish mines regularly pass into the hands of the same smelters, who purchase them for the purpose of separating the more valuable metal. In 1855, the amount of silver ore imported was about 7,222 tons, and from this there was obtained 2,112,246 ounces of silver, worth upwards of 500,000*l.*

The import and export trade in lead shows that both have steadily increased.

Lead Imported.

	Ore.	Pig and Sheet.	Retained for Home Consumption.
	Tons.	Tons.	Tons.
1848.....	1,298	3,788	2,157
1849.....	1,380	7,215	5,265
1850.....	1,700	11,875	6,941
1851.....	2,790	14,591	8,235
1852.....	802	13,257	12,990
1853.....	733	17,564	....
1854.....	....	11,858	....

Lead Exported.

	Ore.	Pig and Sheet.	Shot.	Litharge, Red and White Lead.	Foreign Lead.
	Tons.	Tons.	Tons.	Tons.	Tons.
1848	135	4,977	1,151	2,292	3,747
1849	180	15,227	1,798	3,798	5,161
1850	165	20,165	1,750	4,717	3,217
1851	133	18,029	1,459	3,784	4,287
1852	195	18,641	1,355	3,389	2,966
1853	488	14,935	1,307	2,869	1,438
1854					

The Parliamentary returns of exports and imports for 1854 and 1855 remained, owing to an accidental omission, unpublished at the time of reading this Paper. In connection with the imports of lead, it may be stated that those from Spain exhibit the greatest increase. This is interesting and important, showing the improved value of the Spanish mines, and the advantages which that country is deriving from English industry.

Lead Ore and Lead Imported from Spain.

	Ore.	Lead.		Ore.	Lead.
	Tons.	Tons.		Tons.	Tons.
1845.....	11	2,186	1850.....	656	11,447
1846.....	59	6,517	1851.....	1,851	14,402
1847.....	....	3,267	1852.....	16	12,398
1848.....	51	3,447	1853.....	83	14,979
1849.....	110	6,210	1854.....	....	11,337

The prices of pig lead in the London market, since 1844, has been as follows:—

	£	s.	d.		£	s.	d.
1844.....	17	5	0	1850.....	17	15	0
1845.....	19	0	0	1851.....	16	10	0
1846.....	19	0	0	1852.....	17	0	0
1847.....	20	0	0	1853.....	23	10	0
1848.....	17	5	0	1854.....	23	10	0
1849.....	16	0	0	1855.....	24	0	0

Since the produce of silver from the British mines has engaged our attention, that of GOLD must not be entirely neglected. Gold has been found in the tin streams of Cornwall, in some of the ores of Devonshire, particularly in the gozzans or iron-ochres which occur on the backs of mineral lodes. In Wales, gold has been found in Caermarthenshire, Cardiganshire, and Merionethshire. In the Lead Hills and some other parts of Scotland, and especially in Wicklow in Ireland.

A few words on the last named locality may not be out of place. In 1795, it transpired that lumps of pure gold had been picked up in a valley at the base of the Croghan Kinshela in Wicklow, and hundreds of gold-seekers swarmed along the banks of the stream in which the auriferous treasures were found, and for six weeks they appropriated to themselves a considerable amount of pickings. Then Government, backed by a special Act of Parliament, established a more systematic search, under the direction of Messrs. Mills, King, and Weaver. These works continued to the breaking out of the rebellion in 1798, when they were abandoned, and they were not resumed until 1801. The directors at this time determined on examining the rocks of the mountain itself from which the gold was supposed to be derived. An enormous amount of labour was bestowed on the work, but it was not rewarded by the discovery of even a trace of gold. The gold streaming and the gold mining were eventually abandoned by the Government. They had raised 944 ounces of gold, the ingots of which were $21\frac{3}{8}$ and $21\frac{1}{8}$ carats fine, the alloy being silver, the total value at the time being 3,675*l.* The heaviest lump found weighed 22 oz. The money expended upon these works cannot now be stated with any accuracy, but it is certain that the expenditure infinitely exceeded the returns.

In the Lead Hills of Scotland we learn that some 20,000*l.* were expended to obtain less than 5,000*l.* of gold. The works which have been within the last few years established in Devonshire, with a view to obtaining gold, have been relinquished with enormous loss; and those which were organized to procure gold from the quartz veins of Merionethshire are almost inactive. That gold exists in England is

no new discovery, but that it is to be found in any part of these Islands in quantities sufficiently large to pay for the labour which must be expended in obtaining it, is exceedingly problematical.

We must now pass on to the consideration of the most important of our mineral industries, and one which is immediately connected with our position amongst nations—namely, IRON.

The ores of iron are very widely disseminated, and many districts in which iron exists in great abundance remain untouched; from these we shall no doubt eventually obtain large supplies to meet the steadily increasing demands. The chief sources of the iron ores employed at present in the manufacture of iron, are the coal-fields—in which beds of argillaceous iron ore, or clay iron-stones, are found often regularly interstratified with the coals and shales. Many of the coal-producing districts do not produce iron, but if I give, in the first instance, the localities of the blast-furnaces and their numbers, and then name the sources from which each set of furnaces receive their supply of ore, the distribution of the iron trade will be clearly shown. I may here remark that, hoping to be enabled at some future time to present to the Society a complete statistical examination of the progress of the iron trade in Great Britain, I shall avoid doing more on this occasion than giving a correct view of the present extent of our pig-iron manufacture.

The exact number of iron furnaces in blast in 1855 has not yet been determined for the entire kingdom; it differs but little from the number at work in 1854, which will be found in the following table:—

Iron Furnaces in Great Britain.

County.	Number of Works.	Furnaces in Blast.	Furnaces out of Blast.	Total Built.
Northumberland and Durham	23	59	19	78
Yorkshire	14	21	7	28
Derbyshire	13	25	8	33
Cumberland	1	2	2	2
Lancashire	1	2	1	3
North Staffordshire	7	21	7	28
South Staffordshire	65	145	30	175
Shropshire	13	28	6	34
Denbighshire	7	9	2	11
Glamorganshire and Monmouthshire	48	121	48	169
Gloucestershire	4	5	2	7
Ayrshire	9	30	11	41
Lanarkshire	13	72	16	88
Fifeshire	4	9	3	12
Argyleshire	1	1	....	1
Linlithgowshire	1	3	1	4
Stirlingshire	2	3	2	5
Clackmannanshire	1	1	2	3
Dumbartonshire	1	1	1	2
Haddingtonshire	1	1	1	2
	228	559	169	728

The furnaces of Scotland are corrected for 1855.

The pig-iron furnaces of the Northumberland district were supplied from the adjoining counties, but little iron-stone being raised in these great coal-fields, a large quantity of carboniferous iron ore was sent from Scotland, and they now receive not less than 50,000 tons of hæmatite annually from Whitehaven. Within the last few years an enormous quantity of iron ore has been found in the oolitic formations of Cleveland, and, in 1854, 650,000 tons of this iron ore were consumed by the blast-furnaces on the Tyne. The hæmatite formations of Whitehaven and Ulverstone are the most remarkable in this country. This peroxide of iron occurs at Whitehaven in great vaults, and in caverns in the limestone, while at Ulverstone it is deposited, as if in pools or lakes formed in the underlying rock. Of these hæmatite ores, in 1854,

The Newcastle district took	46,785 tons.
The Birkenhead Railway received and distributed	13,380 „
The North-Western Railway took into Staffordshire } principally	200,000 „
Coastwise there were sent to South Wales	150,000 „
The Whitehaven Hæmatite Iron Works and the char- } coal furnaces at Ulverstone used	32,926 „
Distributed in other directions, principally coastwise....	136,833 „

The total quantity of hæmatite iron raised annually in this district falling but little short of 600,000 tons.

The iron ores employed in the manufacture of iron in the furnaces of Yorkshire and Derbyshire are raised principally from the coal-fields of those districts. During each of the last two years not less than 700,000 tons of iron ore must have been raised in these localities.

It may appear that the enormous demands of 1855 for shot and shells would have greatly increased the quantity of ore employed. This was not the case in any remarkable degree, as nearly all the shot and shells were made from old iron collected from every part of the country.

Staffordshire, North and South, used not less than two millions and a-half tons of iron ore in each of the last two years. Much of this ore is raised in the county; but, in 1854, 213,500 tons were brought into Staffordshire from Northamptonshire, and in 1855, 74,084. Enormous deposits of an iron ore, an hydrated oxide of iron, have been discovered in Northamptonshire, and may be looked to for many years as a source of supply. Shropshire consumed, in 1854, 374,400 tons of ore, nearly all of which is raised in the district.

The Iron works of North Wales consumed about 100,000 tons, while those of South Wales appear to have required nearly two millions and a-half of iron ore for their supply. The Dean Forest furnaces used the ore raised in the forest,—85,506 tons of hæmatite ore.

Considerable quantities of spathose iron ore are sent into South Wales from Devonshire and Somersetshire, and in these counties, spread out under the new red sandstone, there appears to exist a bed, varying in thickness, but tolerably continuous, of an iron ore of fine quality. Cornwall produces hæmatite and some spathose iron.

The iron ores of the tertiary rocks are now exciting attention, and the probability is that, within a few years, the iron ores of the Eastern Counties, from which at one period nearly all the British iron was obtained, will again become as valuable as they once were.

There were formerly 10 blast furnaces in Sussex, and 4 in Kent, and there were in these counties about 9 forges. They used charcoal as a fuel, and, with the destruction of the wood, and the introduction of the use of coal in smelting iron by Mr. Dudley, in 1619, the sites of the iron industries were changed. The only charcoal iron furnaces in this country at present, are those belonging to the firm of Harrison, Ainslee, and Co., at Ulverstone, and one in Scotland. In Scotland the iron is chiefly made from the black band iron which was discovered by Mr. Mushet in 1801. The great development of the Scotch iron trade is immediately dependent on this discovery. Mr. Mushet himself remarks, after speaking of the number of iron furnaces in the course of erection,—

“ This prosperous state of affairs not only abundantly enriches the iron masters who are in possession of the carboniferous iron-stone, but has raised in an unprecedented manner the value of the mineral property in the neighbourhood of the furnaces. The estate of Airdrie, for instance, now returns to the proprietor for royalty, on black band discovered by me in 1801, 12,000*l.* a year; whereas, formerly, not one shilling of mineral rent was obtained.”

The quantity of iron produced in all these districts, in 1854, was as follows:—

Produce of Pig Iron in 1854.

Northumberland, Durham, and Yorkshire.....	275,000 tons.
Cumberland and Lancashire	20,000 „
Yorkshire	73,444 „
Derbyshire	127,500 „
Staffordshire	847,600 „
Shropshire	124,800 „
Flintshire	32,900 „
SOUTH WALES	750,000 „
Gloucestershire	21,990 „
SCOTLAND	796,604 „
	<hr/>
	3,069,838 „

The quantities of iron made in England and Wales, and Scotland, in the following years, will serve to show the progress which has been made in our iron manufacture:—

		Tons.	Tons.
1740.	Charcoal pig iron	17,350	
1788.	Charcoal pig iron	13,100	} = 61,300
	Coke pig iron	48,200	
	Charcoal and coke furnaces } in Scotland		7,000
1796.	England and Wales.....	108,993	} = 125,079
	Scotland	16,086	
1806.	Great Britain		258,206
1830.	Do.		678,417
1839.	Do.		1,248,781
1847.	Do.		1,999,608
1852.	Do.		2,701,000
1854.	Do.		3,069,838

Such is the enormous increase of our iron manufacture in little more than a century.

The average market price of pig-iron may be taken at 5*l.* per ton, which gives the total value of our manufacture of pig-iron as

15,349,190*l*. In the process of manufacture into bar-iron and steel this is greatly increased. A few of the extreme variations in the price of bar-iron will place this at once before us.

	£	s.	d.		£	s.	d.
1806 { Merchant bar iron at }	17	10	0	1832 { Merchant bar iron at }	5	15	0
1810 { Liverpool	13	19	0	1836 { Liverpool	11	15	0
1813 " "	12	0	0	1840 " "	7	10	0
1816 " "	8	10	0	1843 " "	4	15	0
1818 " "	13	0	0	1845 " "	10	10	0
1821 " "	8	5	0	1852 " "	4	15	0
1825 " "	15	0	0	1854 " "	11	0	0
1828 " "	8	0	0	1855 " "	10	0	0

I shall avoid on the present occasion anything beyond a general notice of our iron exports for the reason before stated; Mr. McCulloch's statement for 1850 may be taken as a fair representation of the general export trade even at the present time:—

"About three-tenths of the total quantity of iron is used in the state of pig or cast-iron, and is consumed principally in Great Britain and Ireland. The exports of pig-iron, however, amounted, in 1850, to about 142,000 tons, sent principally to the United States, Holland, Prussia, France, and British North America. The other seven-tenths are converted into bars, bolts, rods, &c. The export of bar-iron amounted, in 1850, to nearly 443,000 tons; and, during the same year, the exports of all sorts of iron reached the prodigious amount of 783,423 tons 5 cwt., which at 7*l*. a ton would be worth 5,483,963*l*., and their declared value did in fact amount, in 1850, to 5,483,963*l*."

Our exports were, in

	1853.	1854.
	Tons.	Tons.
Pig iron	333,585	293,432
Bar iron	644,886	604,662
Rod "	9,016	12,056
Cast "	60,979	69,338
Wire	9,912	7,937
Anchors, &c.	20,651	26,084
Hoops	26,199	30,709
Nails	7,970	8,141
Various sorts	111,652	111,269
Steel, unwrought	20,288	20,793
	1,245,138	1,184,421

Of hardware and cutlery there were exported, in

	Tons	cwt.	£
1853.....	32,375	5	The declared value 3,665,051
1854.....	32,054	3	„ 3,867,598

In addition to the metalliferous productions already named, there were obtained from the mines of Cornwall, Wales, Cumberland, and the Isle of Man, during 1855, not less than 5,000 tons of zinc ore in the shape of sulphuret of zinc, or black-jack; and calamine, a carbonate of oxide of zinc. The estimated value of this was at least 17,000*l*. In all probability a new era for our zinc mines is approaching, the

price for the ore is advancing, and it is now selling at prices varying from 2*l.* 10*s.* to 3*l.* per ton. The great supply of zinc for this country has hitherto been derived from the works of the Vieille Montagne Company, our imports having been as follows:—

	Zinc.	Oxide of Zinc.	
	Tons.	Tons	cwt.
1850.....	18,626	170	16
1851.....	22,986	495	9
1852.....	18,505	787	9
1853.....	23,418	342	0
1854.....	19,583	336	0

The great resources of Belgium are rapidly failing. New and economical processes for the smelting of zinc are being introduced, and we may therefore hope that the stores of zinc ore in this country, which were said in the days of Queen Elizabeth to be *inexhaustible*, and which are far from fully developed, may be turned to profitable account.

Our Islands produce antimony, nickel, cobalt, manganese, and some other metals of use in the arts. Formerly Cornwall supplied antimony to the type-founder; now I am not aware that one ton a year of antimony, produced in this country, is sold. We import all the antimony which we use. Of nickel and cobalt the St. Austle Consols in Cornwall sold last year about 150 tons, and the mines belonging to the Duke of Argyle in Scotland produced about 300 tons, averaging about 6 per cent. for nickel. Norway and Germany supply all the nickel which our white metal manufacture requires.

The sulphur ores of this country are not now used in any large quantities, the price of Sicilian sulphur being so low as to render it more profitable to the sulphuric acid and soda manufacturer to employ it than our own iron pyrites. The Irish sulphur ores, however, still find a market, and are used in the chemical-works at St. Helens. Since 1840, the production of Wicklow and Arklow has been as follows:—

	Wicklow.	Arklow.	Total.*
	Tons.	Tons.	Tons.
1840.....	27,172	13,004	40,176
1841.....	40,823	36,565	77,388
1842.....	20,494	19,963	40,457
1843.....	19,995	19,191	39,186
1844.....	15,772	19,189	34,961
1845.....	9,573	29,445	39,018
1846.....	10,815	25,245	36,060
1847.....	10,619	29,889	40,508
1848.....	15,462	25,777	41,239
1849.....	19,103	26,524	45,627
1850.....	24,221	49,823	74,044
1851.....	29,399	73,039	102,438
1852.....	30,770	67,218	97,988
1853.....	30,150	82,100	112,250
1854.....	34,000	90,000	124,000
	338,368	606,972	945,340

* Tons of 21 cwt.

Cornwall and Devonshire produce annually not less than 1,500 tons of arsenic; a considerable portion of this is employed for the purpose of giving the required whiteness to copper in our white metal manufactures, and a large quantity is exported to Russia, and other places, where it is used in dressing furs and skins. Beyond this our Salt mines produce not less than 1,000,000 tons of Salt per annum. Barytes may be obtained in large quantities. The china clays of Cornwall, the clays of Pool in Dorsetshire, and other places, form an important, but hitherto unestimated, item in our mineral produce. Beyond these our granites, slates, sandstones, and other building stones, together with the ornamental limestones of Derbyshire and Devonshire, and the serpentine of the Lizard in Cornwall—one of the most beautiful of ornamental stones, and now coming extensively into use—would swell the total value, could the quantities produced be accurately ascertained. This has not hitherto been done, but I am organizing arrangements by which I hope to arrive at the real value of our earthy minerals.

Last in the order of my plans—but the most important by far, as giving us the means of rendering our metalliferous productions available—is COAL. During last year I visited every coal-field in Great Britain, and with much labour obtained returns of far more exactness than any which had been got previously.

The collieries of the United Kingdom are distributed as follows:—

Pembrokeshire	19	Lancashire	333
Glamorganshire and Mon-	227	Cheshire	30
mouthshire		Cumberland	23
Flintshire	30	Durham and Northumber-	225
Denbighshire	25	land	
Anglesea	5	Lanarkshire	153
Devonshire	2	Ayrshire	78
Gloucestershire and Somerset-	85	Fifeshire	34
shire		Clackmannanshire	8
Shropshire	48	Haddingtonshire	11
South Staffordshire	393	Edinburghshire	11
North Staffordshire	123	Linlithgowshire	15
Nottinghamshire	17	Stirlingshire	34
Warwickshire	15	Dumbartonshire	11
Leicestershire	11	Renfrewshire	7
Derbyshire	123	Other counties	6
Yorkshire	276	IRELAND	19
Wales	306		
England	1,704		
Scotland	368		
Ireland	19		

Total 2,397 collieries in the United Kingdom.

This does not, of course, represent the *Pits*, which are far more numerous.

The annual coal produce of these Islands has been variously estimated as being 31,500,000 tons, 34,000,000 tons, and 56,550,000 tons. Between these sums numerous others have been given, all of them, however, clearly the result of guesses rather than of careful examination. With a view of determining with all the exactness possible this important question, I issued circulars to nearly all the

coal proprietors of the kingdom, I made personal inquiries over every district, and, I am bound to declare, that, as soon as the purposes of my inquiry were understood, I almost invariably was furnished with the means of making my computation with correctness. Scarcely any of the large coal proprietors refused me the information I sought. The great railway companies carrying coals, without exception, gave me, often at an enormous amount of labour to themselves, copies of their traffic returns carefully digested, so as to show me the locality from which the coal was received, and the districts over which it was distributed. The coal exported and carried coastways was easily obtainable. The greatest difficulty arose in endeavouring to estimate the quantities consumed at the collieries for the machinery and by the workmen; and again the quantities carried by carts into the neighbouring towns. By the aid of agents and viewers I was, however, enabled to approximate very closely to the truth as it regards the first, and by obtaining returns from turnpike gate-keepers and carriers, to arrive yet more nearly to the consumption of the large towns.

By these means I was able to determine that the local annual consumption of

Newcastle-on-Tyne	was about	1,400,000 tons
Sheffield	"	600,000 "
Leeds	"	575,000 "
Manchester and Salford	"	1,850,000 "

and similar proportions for many other large towns.

It has been estimated, which is nearly correct, that the consumption of coal in the metropolis is one ton per annum for every man, woman, and child of the population. In the large manufacturing towns the consumption is not under three tons per annum for each head of the population.

The result of my inquiries, as it respects the actual coal produce of the country in 1854, was as follows:—

Northumberland and Durham	15,420,615 tons.
Cumberland	887,000 "
Yorkshire	7,260,500 "
Derbyshire	2,406,696 "
Nottinghamshire	813,474 "
Warwickshire	255,000 "
Leicestershire	439,000 "
Staffordshire and Worcestershire	7,500,000 "
Lancashire	9,080,500 "
Cheshire	786,500 "
Shropshire	1,080,000 "
Gloucestershire, Somersetshire, and Devon- shire	1,492,366 "
WALES	9,643,000 "
SCOTLAND	7,448,000 "
IRELAND	148,750 "

Total coal produce of the United King- dom in 1854	64,661,401 "
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I have now given what, after a very close and attentive examination, may be regarded as the closest result yet obtained of the produce of our metalliferous mines and our coal fields. I have estimated the

actual value for 1854, as far as can be at present ascertained, of the metals and coals on the surface of the mine or at the pit's mouth, and pig-iron at the furnace, independent of any of the additions which must necessarily be made before these substances can reach the public, as follows:—

	£
Tin.....	559,808
Copper	1,263,739
Lead	1,400,000
Silver.....	147,500
Iron	9,500,000
Coal	15,000,000
Zinc	16,500
Nickel, arsenic, sulphur, and other minerals	750,000
	<hr/>
	28,637,547

When to this our valuable clays and building and ornamental stones, are added, the immense importance of our mineral treasures becomes apparent. The above computation, it must not be forgotten, gives the value of our mining products in their simplest forms; by every step of manufacture the value is vastly increased. The production of the ores of the metals and coals, in the actual processes of mining, and preparing the ores on the surface of the mines and collieries, gives employment to 303,977 men and women. These are distributed as follows:—

	Men and Women of all Ages.
Coal.....	219,995
Iron.....	26,106
Copper	21,169
Tin	14,761
Lead	21,749
Zinc, &c.	174
	<hr/>
	303,977

In conclusion I must venture a few words upon the commercial value of our mining operations. Mining is, and, it is to be feared, must remain for some time to come, in many respects uncertain in its results. I have, however, already indicated some *constants* in nature which may serve to guide the adventurer upon this division of human industry, and without doubt others are to be discovered by careful search.

An examination of some recent lists of the mining companies and their capitals, for a single year, shows that not less than 5,000,000*l.* sterling were subscribed, ostensibly for working the copper, tin, and lead mines of the United Kingdom. Of this sum, it appears that considerably less than 1,000,000*l.* was actually expended for the purposes of exploration, the remaining four millions being exhausted in the mysterious operations of the share market. Nothing can be more injurious to the mining interest of this country than the system of misrepresentation which so largely prevails. So long as this is persevered in, mining can only progress by a system of convulsive throbs—we shall have a year of excitement, followed by a year of depression, and individual ruin and

national loss must be the result. The moral evils extend in every direction; the want of truthfulness in the metropolis is met by a disregard of truth in the provinces; deception is met by misrepresentation. Indifference as to the real object, or what should be the real object, is generated; and, instead of carefully exploring a mine, the aim of all concerned is to advance, by any means, the price of shares, and mining becomes a game as exciting as any other gambling transaction, and similar results usually ensue.

I feel warranted in saying, after a most attentive consideration of the subject, that mining, legitimately carried out, commenced with proper judgment, guided by the advice of experienced persons, and directed with honest intentions, is as satisfactory a speculation as any in which a capitalist can engage.

In evidence of this, I may adduce an instance of the result of undeviating honesty, and ordinary caution. Upwards of fifty mining adventures were entered on—these represented a net capital of about 500,000*l.*; the mines were worked, exhausted, and abandoned. During the period between their commencement and termination these mines made a profit of upwards of 800,000*l.* I might mention several similar instances both of single mines and of groups of mines in support of my view.

The want, not merely of scientific knowledge, but of that clearness of mind, which an education, calling into action the powers of observation and of reflection, can alone produce, is evident to all who examine with care the progress of mining.

Errors are continually forcing themselves upon attention; errors in surveying, and in mapping what has been surveyed; errors in engineering, producing a great waste of mechanical power, and often a needless outlay of capital; and errors arising from a want of even a rudimentary knowledge of mineralogy and of metallurgical chemistry. I could give special examples of each of these sets of errors if it were desirable to do so.

An habitual carelessness, too, marks many of our operations. When passing over our coal-fields we see naked boilers exposed to winds, rains, frosts and snows; burning piles, and ash-spread wastes, mark the way to a colliery; desolation reigns supreme in a robe of smoke on her throne of fire.

The drain at present upon our coal-fields is infinitely greater than it has been at any previous period; and, it should be remembered, that the coal-fields of Great Britain are not inexhaustible—the age of coal formation is gone by.

Surely, when we consider the great value of our mineral productions, the immense amount of engineering skill which is called into operation by the processes of mining, the extension of all our metallurgical operations, and hence the increasing demand upon the earth for supplies of the raw material, the difficulties of obtaining which are constantly increasing with the depth of our mines, and the vast amount of labour which mining and metallurgy creates, it will be evident to all that a legitimate system should be pursued if possible, and a sound practical knowledge steadily enforced. The almost entire ignorance of the great mass of the public, on all subjects connected with our mineral produce, lays them open to be deceived

by the representations of the pretender. The extension of knowledge in this direction, may therefore aid considerably in improving the character of mining speculations.

It is no trifling matter to be coolly passed by ; the drain upon Nature's stores is now going on at an enormous rate. We are as stewards in charge of this vast property, and when we reflect that England's position in the commercial scale of nations is dependent upon her judiciously employing the vast treasures which are spread through her sea-girdled rocks—upon the skill with which she directs her native industry—upon the powers of mind which are brought to bear upon the search for mineral treasures, and upon the methods for rendering them available when found, it cannot but be evident to all that an education combining scientific knowledge, and the powers for applying that knowledge, is the great want of the day.

We should remember, too, that though our forefathers left us a rich inheritance, our children's children may have to reflect upon their injudicious grandsires. The past becomes the instructor of the present in its duty to the unknown future. The storehouse of wealth, upon which we draw so largely, should be guarded—as Merlin protected the fabled treasures of the Cambrian hills,—by the constant watch of sleepless eyes, rendered more penetrating by the touch of the prophet's wand of science.

(*Note.*—In the interval which has passed between the reading and the publication of this Paper, the “Mineral Returns” for 1855 have been obtained and published.--R. H.)
